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(54) [Title of the Invention] Contamination adhesion prevention agent for use in a papermaking drying process

(57) [Abstract]
[Object] A contamination adhesion prevention agent is proposed to enable improvements in paper quality and productivity by preventing the adhesion of paper dust and/or pitch by applying same in a papermaking drying process at extremely low usage amounts.
[Constitution] To an (O/W) emulsion of a mixture whose weight ratio of a silicone oil emulsion (O/W type, silicone oil: 30% to 65%) having a viscosity of less than 1,000 cst (at 25°C) and a silicone oil emulsion (O/W-type, silicone oil: 20% to 40%) having a viscosity of at least 100,000 cst (at 25°C) or which is curable is from 9:1 to 5:5, is added from 0.01% to 5.0% of a fluorine-based surfactant by weight with respect to the silicone oil.

[Claims]

[Claim 1] A contamination adhesion prevention agent for a papermaking drying process wherein to an (O/W-type) emulsion of a mixture whose weight ratio of a silicone oil emulsion (O/W type, silicone oil: 30% to 65%) having a viscosity of less than 1,000 cst (at 25°C) and a silicone oil emulsion (O/W-type, silicone oil: 20% to 40%) having a viscosity of at least 100,000 cst (at 25°C) or which is curable is from 9:1 to 5:5 is added from 0.01% to 5.0% of a fluorine-based surfactant by weight with respect to the silicone oil.

[Detailed Description of the Invention]

[0001]

[Industrial Field of Application]

The present invention relates to contamination adhesion prevention agents capable of improving paper quality and productivity by preventing the adhesion of paper dust and/or pitch by applying same in the papermaking drying process at extremely low usage amounts.

[0002]

[Prior Art] In recent years, the use of recovered waste paper with the object of re-using raw materials has become more frequent in paper manufacturing. In addition, because internally added chemicals are increasingly being added even in normal papermaking, operational problems resulting from the contamination of canvases and dryers in the papermaking drying process have become a focus of attention. In particular, operational problems are increasing as a result of the adhesion of sticky pitch generated by gums, hot melts, paper strengthening agents and the like, and from the adhesion of contaminants such as paper dust and the like. In other words, canvas contamination causes a drop in air permeability, leading to drying defects and making the moisture profile non-uniform, or it causes problems such as the transfer and adhesion of pitch to the paper, and thus, the canvas becomes unusable in 3 to 6 months and must be replaced. In addition, dryer contamination causes problems such as paper drying defects, non-uniform treatment of the paper surface, paper splits (wherein a portion of the paper surface is defective), paper breaks, and the like. Problems which occur in this manner cause a deterioration in paper quality and a drop in productivity.

[0003] As countermeasures to the above-mentioned problems, methods have been attempted to physically remove contaminants adhering to the surface by installing a brush cleaning machine and/or high-pressure washing machine which act on the canvas, and by installing a doctor [blade] treated with a Teflon finish to act on the dryer, but these have not yielded adequate results.

[0004] In addition, a method intended to prevent contamination and improve productivity by spray-misting an oil-in-water-type (O/W-type) emulsion of an oily substance onto the dryer surface, thereby forming an oil film layer having lubricating properties, has been proposed in Publication of Unexamined Japanese Patent H4-130190. The object in making [the emulsion] an oil-in-water type (O/W-type) in the aforementioned method is to reduce flammability.

[0005]

[Problems the Invention is to Solve] Nevertheless, in the methods of the aforementioned prior art, some effect can be observed when at least several percent of the oily substance is incorporated into the emulsion, but when only around 0.5% or less of the oily substance is incorporated into the emulsion, no adequate oil film layer can be formed, and thus effects such as preventing the adhesion of contaminants, etc., are remarkably low. In other words, in these methods, an extremely large amount of the oily substance must be used, and thus economic efficiency is extremely poor. Consequently, there is demand for the development of a chemical agent which exhibits a high contamination adhesion prevention effect at low usage amounts (low concentrations).

[0006]

[Means of Solving the Problem(s)] The present invention gives careful consideration to the aforementioned economic efficiency, and its objective is to maintain the dryer surface and/or canvas surface in a constantly clean state at low usage levels, thereby improving productivity by preventing a deterioration in the quality of the paper and a drop in drying efficiency, and in addition, significantly extending the durability and usage time of the canvas and/or dryer. It proposes a contamination adhesion prevention agent for papermaking drying processes wherein, to an (O/W-type) emulsion of a mixture whose weight ratio of a silicone oil emulsion (O/W type, silicone oil: 30% to 65%) having a viscosity of less than 1,000 cst (at 25°C) and a curable silicone oil emulsion (O/W-type, silicone oil: 20% to 40%) or one having a viscosity of at least 100,000 cst (at 25°C) is from 9:1 to 5:5, is added from 0.01% to 5.0% of a fluorine-based surfactant by weight with respect to the silicone oil.

[0007] The aforementioned contamination adhesion prevention agent for a papermaking drying process of the present invention exhibits its effect at low concentrations, in particular, at silicone oil concentrations of less than 0.5%, and is employed by diluting with water at the time of use. That is, the contamination adhesion prevention agent which forms the stock solution is ordinarily adjusted to a proportion such that the total silicone oil is from 20% to 50% by weight, the emulsifying agent is from 0.5% to 5% by weight, the fluorine-based surfactant is from 0.002% to 2.5% by weight, and the remainder is water in the mixture.

[0008] Silicone oils are widely utilized as mold release agents, but no useful effect can be achieved by employing a low-viscosity silicone oil emulsion having a viscosity of less than 1,000 cst (at 25°C) and a high-viscosity or curable silicone oil emulsion having a viscosity of at least 100,000 (at 25°C) individually. In addition, no useful effect can be obtained by emulsifying both a low-viscosity silicone oil and a high-viscosity or curable silicone oil at the same time. In other words, an effect as a contamination adhesion prevention agent for the papermaking drying process can first be obtained by pre-mixing and combining specific proportions of a low-viscosity product and a high-viscosity product or curable product of silicone oils, respectively, as an emulsion (O/W-type) as in the above-mentioned present invention. The effect of this combination can be considered to be the result of the synergistic effect of the adhesion prevention properties possessed by the low-viscosity product, and the film-forming properties possessed by the high-viscosity product or the curable product derived from its adhesion strength and bonding properties to the surface of the dryer or canvas. Meanwhile, only the low-viscosity product is readily adsorbed by the paper as a result of its fluidity, and almost none remains as a film on the surface of the dryer or canvas. Only the high-viscosity product has film-forming functions, and because of the stickiness and consistency of the

film itself, instead of preventing contaminants from adhering, it conversely causes contaminants to adhere readily. In addition, there is almost no adhesion prevention effect using only a curable product. Further, in using only a silicone oil emulsion having an intermediate viscosity between the aforementioned low-viscosity product and high-viscosity product, for example, a viscosity of from 5,000 to 50,000 cst (at 25°C), both the contamination adhesion prevention effect and film-forming performance are inadequate. Plus, no useful effect can be obtained by emulsifying a low-viscosity silicone oil and a high-viscosity or curable silicone oil together at the same time, which is similar to the case of making single products consisting of emulsions of average viscosity silicone oil mixtures into emulsions individually.

[0009] In other words, because the present invention as described above pre-mixes and combines a low-viscosity silicone oil emulsion and a high-viscosity or curable silicone oil emulsion which are emulsified (O/W-type) separately in advance, a plural number of types of emulsified microparticles exist in the mixed liquid. When this mixed liquid is sprayed on the surface of the dryer or canvas, a film is formed after the water fraction evaporates, but it is not a film wherein the low-viscosity silicone oil and the high-viscosity or curable silicone oil are uniformly mixed. Rather, it forms a film wherein the low-viscosity silicone oil and the high-viscosity or curable silicone oil exist, respectively, in a layered state. The high-viscosity or curable silicone oil readily adheres to the surface of the dryer or canvas, and conversely, it makes it difficult for the low-viscosity silicone oil to adhere. Thus, a small amount of the low-viscosity silicone oil exists within large amounts of the high-viscosity or curable silicone oil in the layer in the film at the dryer or canvas surface; the layer on the top surface side is the converse thereof. As a result, a layer that prevents contaminants from adhering is formed on the film top surface, and a layer is also formed which adheres to and is in intimate contact with the dryer or canvas.

[0010] Consequently, the contamination adhesion prevention layer which is primarily composed of the low-viscosity silicone oil formed on the film surface in reality migrates to the paper while preventing the adhesion of contaminants such as paper dust or pitch and the like, but because the low-viscosity silicone oil which has adhesion prevention properties is incorporated into the high-viscosity or curable silicone oil in the layer on the dryer or canvas surface side, the contamination adhesion prevention effect is sustained.

[0011] Examples of silicone oils as described above include dimethyl polysiloxane oil, polyester-modified silicone oil, carboxyl-modified silicone oil, alcohol-modified silicone oil, epoxy-modified silicone oil, amino-modified silicone oil, methylhydrogen polysiloxane oil, alkyl/aralkyl polyester-modified silicone oil, and the like, and can be arbitrarily selected and used as the aforementioned low-viscosity silicone oil and as the aforementioned high-viscosity or curable silicone oil. In general, a dimethyl polysiloxane-based oil is economical and is used as the aforementioned low-viscosity silicone oil and as the aforementioned high-viscosity silicone oil. In addition, an amino-modified silicone oil, carboxyl-modified silicone oil, and the like can be used as the aforementioned curable silicone oil.

[0012] Examples of emulsifying agents to emulsify the aforementioned silicone oils into an oil-in-water-type (O/W) emulsion include non-ionic polyoxyethylene alkyl ethers, polyoxyethylene alkyl phenol ethers, polyoxyethylene fatty-acid esters, and the like. Examples of anionic [emulsifying agents] include polyoxyethylene alkyl ether sulfates, alkyl sulfates, polyoxyethylene alkyl ether phosphates, alkyl sulfosuccinates, and the like. In addition to these, various types of amphoteric and cationic silicone oils can also be arbitrarily used in combination for the sake of emulsion stability.

[0013] It should also be noted that the aforementioned low-viscosity silicone oil and the aforementioned high-viscosity or curable silicone oil of the contamination adhesion prevention agent of the present invention as described above are mixed in a proportion of from 9:1 to 5:5 by weight, and that if their proportion is outside the aforementioned range, they will approach the performance of the individual silicone oils alone, yielding no useful effect. An effective contamination adhesion prevention agent based on an oil-in-water-type (O/W-type) emulsion of the oily substances of the aforementioned prior art can be obtained based on this combination as described above, but to further improve the performance of the contamination adhesion prevention agent for a papermaking drying process in the present invention, a fluorine-based surfactant is added. Adding this fluorine-based surfactant improves wettability with respect to the dryer or canvas, and further, a more adequate silicone oil film is formed, and an improvement in the contamination adhesion prevention effect is evident.

[0014] From 0.01% to 5.0% by weight of the above-mentioned fluorine-based surfactant is added with respect to the silicone oil. From 0.05% to 3.0% by weight is preferable. When the amount of the fluorine-based surfactant added is less than 0.01% with respect to the silicone oil, it yields an effect similar to adding nothing at all. When more than 5.0% by weight is added, no significant improvement in performance is evident; rather it becomes a disadvantage from the standpoint of economic efficiency. It should also be noted that it is desirable that the amount of the aforementioned fluorine-based surfactant to be added be set appropriately within the aforementioned range according to the concentration of the silicone oil to be used. Normally, when the silicone oil concentration is low, it is better that the amount thereof to be added is high, and conversely, when the concentration is high, that it is less.

[0015] There are no particular restrictions on such fluorine-based surfactants, and examples include non-ionic [types] of a perfluoroalkyl ethylene oxide adduct; anionic [types] of salts of a perfluoroalkyl sulfonic acid or a perfluoroalkyl carboxylic acid (wherein, the salt is K, Na, Li, NH_3, and the like); amphoteric [types] of a perfluoroalkyl betaine; and cationic [types] of a perfluoroalkyl quaternary ammonium salt. In the present invention, anionic [types] and non-ionic [types] are particularly effective.

[0016] It should also be noted that, ordinary hydrocarbon-based surfactants are also effective in terms of improving only wettability, but almost no contamination adhesion prevention effect was evident at the extremely low concentrations of the silicone oils in the present invention. For example, when the amount of the aforementioned hydrocarbon-based surfactant is large, [that is], nearly the same amount as the silicone oil, wettability is improved to a certain extent, but the result is that the contamination adhesion prevention effect intrinsic to the film

is lost completely.

[0017] There are no particular restrictions on the methods of applying the diluted contamination adhesion prevention agent of the present invention comprising the various constituents described above to the surface of a dryer or canvas, and it may be carried out by any specific means.

[0018] For example, in the dryer apparatus shown in Figure 1, an appropriate admixture apparatus is installed at the position indicated by A, and the diluted contamination adhesion prevention agent is generally sprayed onto the canvas from said admixture apparatus. It should also be noted that, in the same Figure, 1 are feed rollers disposed in a zig-zag [arrangement], 2 are small-diameter support rollers, and paper 4 spanning a breadth of 4 to 5 meters is dried in the state wherein it is supported on top of endless canvas 3 which is suspended across these feed rollers 1 and support rollers 2.

[0019] The aforementioned admixture apparatus installed at the position indicated by A has, for example, the constitution shown in Figure 2. This admixture apparatus has a constitution wherein a prescribed proportionate amount of a liquid chemical stock solution 6 (contamination adhesion prevention agent) stored in liquid chemical tank 5 and a prescribed proportionate amount of water 8 stored in demineralized water tank 7 are fed to mixing chamber 11 by pumps 9 and 10, respectively, and are then diluted, uniformly mixed and emulsified in this mixing chamber 11. They are then fed to header 12 upon which nozzles are provided at regular intervals, mixed with compressed air 13 supplied separately, and then sprayed onto the canvas from the nozzles using this air pressure.

[0020] However, when the contamination adhesion prevention agent is sprayed from the aforementioned admixture apparatus, the contamination adhesion prevention agent is atomized by the compressed air, and only around 50% of the silicone oil adheres to the canvas. Because the remaining approximately 50% floats in the air and adheres to something other than the canvas, [this apparatus] has the disadvantage that admixing losses are extremely high.

[0021] In contrast, admixing losses such as those mentioned above can be reduced when the admixture apparatus shown in Figure 3 is used. This admixture apparatus has a constitution wherein rotating shaft 14 which is rotatable by a motor (not shown in the drawing) is disposed above canvas 3, and molded material 15 which is wound of metal, plastic, and the like and formed into a coil shape is wound around in a spiral on the circumferential surface of said rotating shaft 14. The contamination adhesion prevention agent diluted to a prescribed concentration is introduced into a liquid receiver vessel 16 by a supply pathway not shown in the drawing, and is allowed to drop toward the aforementioned rotating shaft 14 under its own weight from a plural number of drip holes 17 provided on the bottom surface of said liquid receiver vessel 16. It should also be noted that the amount to be dropped can be regulated by the diameter of the aforementioned drip holes 17. The dropped contamination adhesion prevention agent then simultaneously adheres to the rotating coil-shaped molded material 15 and becomes airborne and is dispersed in the form of fine liquid droplets by the centrifugal force thereof, and thereby uniformly adheres to canvas surface 3.

[0022] Admixing losses of the contamination adhesion prevention agent can be reduced to around 10% if an admixture apparatus having the aforementioned constitution is used, and moreover, because no compressed air is used, the amount of electric power consumed can also be reduced.

[0023]

[Working Examples] [The present invention] will be explained below by working examples.

[0024] (Working Example 1)

- SM7060 (a product of Dow Corning Toray Silicone Co., Ltd.) 55.0% by weight
  (an emulsion of dimethyl silicone oil; 350 cst; active ingredients: 62%)
- SM8701 (a product of Dow Corning Toray Silicone Co., Ltd.) 20.0% by weight
  (an emulsion of dimethyl silicone oil; 1,000,000 cst; active ingredients: 30%)
- Fluorad FC-98 (a product of Sumitomo 3M, Ltd.) 0.2% by weight
  (a blend of potassium perfluoroalkyl sulfonates; anionic; fluorine-based)
- Water 24.8% by weight

A contamination adhesion prevention agent having the above-mentioned mixed emulsion (O/W-type) composition was diluted 200 times with water (active ingredients: approx. 0.2% by weight), and was spray misted onto the surface of a Yankee dryer in a liner papermaking process (dryer width: 3 m) from 12 spray nozzles under conditions of 0.8 liters/minute. Previously, an oil-in-water-type (O/W-type) emulsion whose primary constituent was spindle oil (active ingredients: 40%) was diluted 100 times, and sprayed from 12 nozzles under conditions of 0.8 liters/minute. However, contamination from pitch and paper dust was found to be adhering to the dryer surface, and the occurrence of some rust was observed. In addition, the adhesion of pitch and irregularities in the manufactured liner paper, as well as paper breaks, occurred intermittently. Further, the unit was cleaned once a week, however both productivity and product quality were poor. In contrast to this, after spray misting the contamination adhesion prevention agent (diluted 200 times) of the aforementioned Working Example 1, the gloss of the silicone film layer began to be evident on the dryer surface approximately 2 to 3 hours thereafter; no contamination from pitch, paper dust, rust, and the like occurred; and a high-quality, uniform liner paper was able to be obtained. In addition, the unit was subsequently used on a continuous basis for one month, but there was no contamination of the dryer surface, and a liner paper having improved quality was obtained. Further, there were absolutely no problems from an operational standpoint such as paper breaks and the like. In addition, thanks to the improvement in drying efficiency, the laying speed was able to be increased by approximately 8% from 850 meters/minute to 920 meters/minute, thereby improving production efficiency.

[0025] (Working Example 2)

- TSM640 (a product of Toshiba Silicone Co., Ltd.) 30.0% by weight
  [an emulsion of dimethyl silicone oil; 350 cst; active ingredient: 30%]

• SM8702 (a product of Toshiba Silicone Co., Ltd.) 15.0% by weight
[an amino-modified silicone oil curable emulsion (forming an elastomeric film coating); active ingredient: 38%]
• Megafak* F-144D (a product of Dainippon Ink and Chemicals, Inc.) 0.1% by weight
[a perfluoroalkyl ethylene oxide adduct; non-ionic; fluorine-based]
• Water 54.9% by weight

A contamination adhesion prevention agent having the above-mentioned mixed emulsion (O/W-type) composition was diluted 100 times with water (active ingredients: approx. 0.15% by weight), and was spray misted onto the canvas (width: 4 m) of a multi-drum dryer in a core [*sic*] manufacturing process from 16 spray nozzles under conditions of 0.8 liters/minute. Previously, because no treatment whatsoever was being applied to the aforementioned canvas, drying efficiency and paper quality would decline as a result of contamination from paper dust, pitch, and the like, and [the canvas] would be replaced after approximately three months. In contrast to this, after spray misting the contamination adhesion prevention agent (diluted 100 times) of the aforementioned Working Example 2 onto a new canvas, almost no contamination from paper dust, pitch and the like was evident on the canvas after the elapse of three months, its appearance was similar to a new [canvas] and drying efficiency was maintained at a level nearly the same as when usage began.

[0026] (Working Example 3)

• TSM641 (a product of Toshiba Silicone Co., Ltd.) 60.0% by weight
[an emulsion of dimethyl silicone oil; 1,000 cst; active ingredient: 30%]
• SM8701 (a product of Toshiba Silicone Co., Ltd.) 39.95% by weight
• Megafak* F-144D (a product of Dainippon Ink and Chemicals, Inc.) 0.05% by weight

A contamination adhesion prevention agent having the above-mentioned mixed emulsion (O/W-type) composition was diluted 200 times with water (active ingredients: approx. 0.15% by weight), and was spray misted onto the canvas (width: 6 m) of a multi-drum dryer in a core [*sic*] manufacturing process from 20 spray nozzles under conditions of 1.0 liters/minute. Previously, because no treatment whatsoever was being applied to the aforementioned canvas, drying efficiency was poor as a result of the adhesion of paper dust, pitch, and the like, and hence, it would be replaced after approximately four months. In contrast to this, after spray misting the contamination adhesion prevention agent (diluted 200 times) of the aforementioned Working Example 3 onto a new canvas, only an insignificant amount of contamination was evident on the canvas after the elapse of four months, and drying efficiency was maintained at a level nearly the same as when usage began.

[0027] (Working Example 4)

• TSM630 (a product of Toshiba Silicone Co., Ltd.) 30.0% by weight
[an emulsion of dimethyl silicone oil; 200 cst; active ingredients: 37%]
• SM8710 (a product of Toshiba Silicone Co., Ltd.) 30.0% by weight
[an emulsion of dimethyl silicone oil; 100,000 cst; active ingredients: 38%]
• Noigen EA-140 (a product of Dai-ichi Kogyo Seiyaku Co., Ltd.) 2.0% by weight
[polyoxyethylene ether of nonylphenol]
• Megafak* F-150 (a product of Dainippon Ink and Chemicals, Inc.) 0.8% by weight
[a perfluoroalkyl trimethyl ammonium chloride]
• Water 37.2% by weight

A contamination adhesion prevention agent having the above-mentioned mixed emulsion (O/W-type) composition was diluted 200 times with water (active ingredients: approx. 0.1% by weight), and was added to the canvas (width: 4 m) of a multi-drum dryer in a core [*sic*] manufacturing process using the admixture apparatus of Figure 3 described previously under conditions of 12 drip holes, a spindle rotational speed of 1,000 rpm, and 1.0 liters/minute. Previously, because no treatment whatsoever was being applied to the aforementioned canvas, drying efficiency and paper quality would decline as a result of contamination from paper dust, pitch, and the like, and hence, it would be replaced after approximately three months. In contrast to this, after adding the contamination adhesion prevention agent (diluted 200 times) of the aforementioned Working Example 4 onto a new canvas using the admixture apparatus of Figure 3, almost no contamination from paper dust, pitch and the like was evident on the canvas after the elapse of three months, and drying efficiency was maintained at a level nearly the same as when usage began. Further, because the admixture apparatus of the aforementioned Figure 3 was used, the amount of electric power used was reduced to approximately 70% of previous levels.

[0028] (Comparative Example 1) The fluorine based surfactant (Fluorad FC-98) was eliminated from the composition of the aforementioned Working Example 1.

• SM7060 55.0% by weight
• SM8701 20.0% by weight
• Water 25.0% by weight

The above-mentioned mixed emulsion (O/W-type) composition was diluted 200 times in manner identical to the aforementioned Working Example 1 (active ingredients: approx. 0.2% by weight), and was spray misted onto the surface of the same dryer under identical conditions. In about 1 week, contamination from pitch, paper dust and the like was somewhat evident, but after approximately 2 weeks, paper dust and the adhesion of pitch to the dryer became strikingly conspicuous, and peeling of the liner paper surface sometimes occurred. Further, when spray misting was continued, the contamination only became worse, and paper breaks also occurred. Ultimately, [the dryer] had to be cleaned after approximately 3 weeks.

[0029] (Comparative Example 2)
The composition below was used wherein the low-viscosity silicone oil emulsion (TSM640) was eliminated from the composition of the aforementioned Working Example 2.

* transliteration

- SM8702 40.0% by weight
- Megafak* F-144D 0.1% by weight
- Water 59.9% by weight

The above-mentioned emulsion (O/W-type) composition [was prepared] in a manner identical to the aforementioned Working Example 2, with the exception of being diluted 100 times (active ingredients: approx. 0.15% by weight), and was spray misted onto a new canvas. In about 1 week, almost no contamination from paper dust and the like was evident, but after approximately 3 weeks, dots of paper dust and the adhesion of pitch to the canvas surface became evident. After the elapse of approximately one-and-a-half months, adhering contaminants such as paper dust and pitch became strikingly conspicuous on the canvas, and pitch contaminants intermittently adhered to the paper surface. Further, drying efficiency declined, and a reduction of approximately 6% in laying speed from 850 meters/minute to 800 meters/minute could not be avoided. Ultimately, the canvas was replaced after four-and-a-half months.

[0030] (Comparative Example 3) The composition below was used wherein the curable silicone oil emulsion (SM8702) was eliminated from the composition of the aforementioned Working Example 2.

- TSM640 50.0% by weight
- Megafak* F-144D 0.1% by weight
- Water 49.9% by weight

The above-mentioned emulsion (O/W-type) composition [was prepared] in a manner identical to the aforementioned Working Example 2, with the exception of being diluted 100 times (active ingredients: approx. 0.15% by weight), and was spray misted onto a new canvas. The results were slightly worse than the aforementioned Comparative Example 2, and ultimately, the canvas was replaced after approximately four months.

[0031] (Comparative Example 4)

- TSM642 (a product of Toshiba Silicone Co., Ltd.; active ingredients: 30%) 50.0% by weight
  [an emulsion of dimethyl silicone oil; 10,000 cst]
- Fluorad FC-98 0.1% by weight
- Water 49.9% by weight

The above-mentioned emulsion (O/W-type) composition [was prepared] in a manner identical to the aforementioned Working Example 3, with the exception of being diluted 100 times (active ingredients: approx. 0.15% by weight), and was spray misted onto a new canvas. The result was that contamination of the canvas was no less than when no treatment whatsoever was applied, but nevertheless, drying efficiency declined, and ultimately, the replacement period for the canvas was extended by no more than approximately one month.

[0032] (Comparative Example 5)

- #1 Spindle oil 2 (a product of Nippon Oil Co., Ltd.) 50.0% by weight
- Noigen ES129 (a product of Dainippon Ink and Chemicals, Inc.) 5.0% by weight
  [a polyethylene glycol oleic acid ester; non-ionic]
- Water 45.0% by weight

The above-mentioned emulsion (O/W-type) composition was diluted 200 times in a manner identical to the aforementioned Working Example 3 (active ingredients: approx. 0.3% by weight), and was spray misted onto a new canvas. The result was that almost no effect was observed, similar to the case when no treatment whatsoever was applied, and ultimately, the canvas was replaced after approximately four months.

[0033] The present invention was explained based on the Working Examples above, however, the present invention is not limited to the Working Examples described above, and can also be worked in any manner so long as the constitution specified in the Claim is not modified.

[0034]

[Advantageous Effects of the Invention] As explained above, when the contamination adhesion prevention agent of the present invention is applied to a papermaking drying process, it becomes possible to prevent the adhesion of paper dust and/or pitch and maintain the cleanliness of the canvas and/or dryer and the like, thereby obtaining paper of consistently high quality without the occurrence of drying deficiencies, and the like, over long periods of time.

[0035] In addition, even though it is diluted to low concentrations so that the amount of silicone oil incorporated into the emulsion is no more than around 0.5% or less, it can impart a contamination adhesion prevention effect to the surface of a canvas and/or dryer and the like. In other words, it exhibits a high contamination adhesion prevention effect at extremely small usage amounts compared to conventional approaches, and its economic efficiency is excellent.

[0036] Further, by maintaining the cleanliness of the canvas and/or dryer and the like over extended periods of time as described above, frequent replacement of the canvas is eliminated. Moreover, by improving drying efficiency, laying speed can be increased, thereby improving productivity, and conjointly with the aforementioned effect, the economic effect is extremely high compared to conventional approaches.

[Brief Explanation of Drawings]

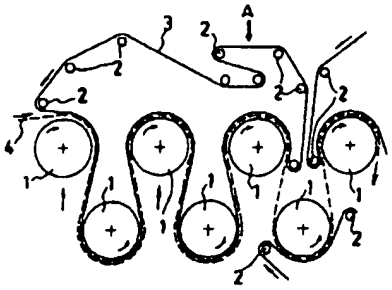
[Figure 1] is a front side view showing schematically an example of a papermaking drying process.

[Figure 2] is a drawing showing conceptually the structure of an example of an admixture apparatus for the contamination adhesion prevention agent.

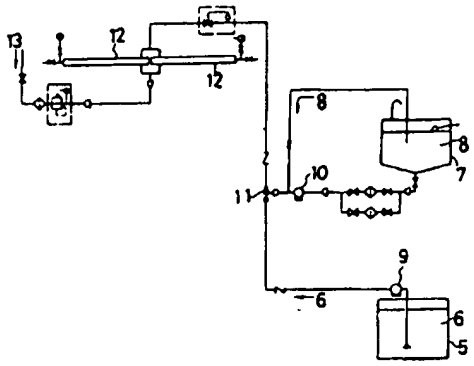
[Figure 3] is a front view showing conceptually the structure of another example of an admixture apparatus for the contamination adhesion prevention agent.

* transliteration

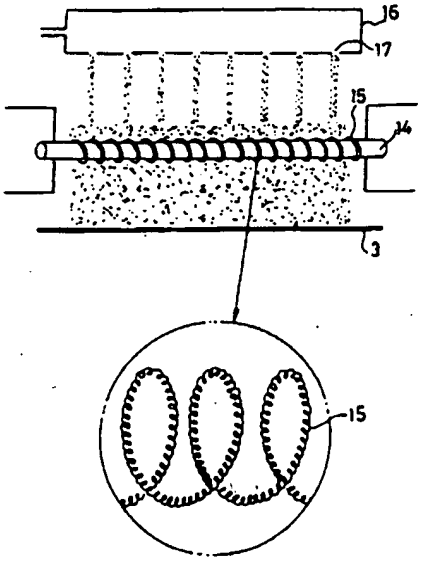
[Figure 1]



[Figure 2]



[Figure 3]



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